Error-Controlled Simulation Database for Orion Pad Abort Test

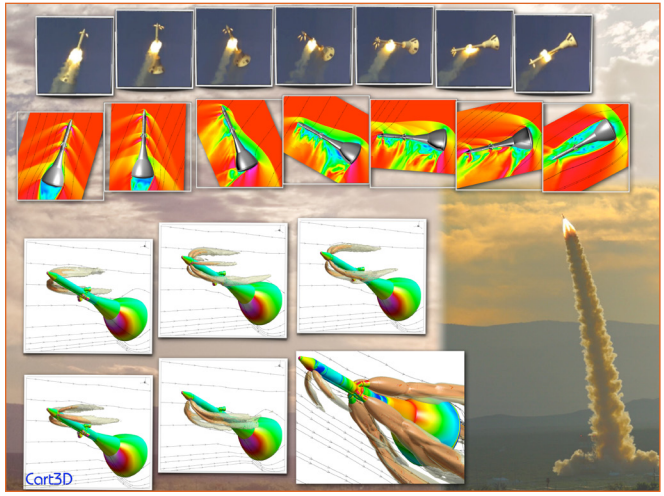
Exploration Systems Mission Directorate

An extensive, error-controlled database of aerodynamic simulations has been generated to support the Pad Abort 1 (PA-1) flight test of the Orion Launch Abort Vehicle (LAV), which is designed to carry the Orion crew module safely away from the launch vehicle in the unlikely event of a catastrophic failure during ascent.

NASA supercomputing resources enabled thousands of numerical simulations to be performed, providing a detailed, quantitative understanding of the vehicle's performance through several design iterations, from concept development through its highly successful flight test. Over 15,000 numerical simulations were performed at the NASA Advanced Supercomputing facility to predict aerodynamic performance and flight loads on the vehicle for the PA-1 test flight. Most of these cases were modeled using NASA's Cart3D computational fluid dynamics code. The simulations also employed a new error-control capability that selectively adapts key regions of the model's computational mesh to minimize resolution-related error in the aerodynamic loads.

Flight loads and aerodynamic performance data from these simulations were used to develop the guidance and control (G&C) system for the vehicle, assess structural design criteria, and ensure that the Orion crew module could separate safely from the rest of the LAV. The design support provided by this data contributed to the success of the PA-1 flight test conducted at the White Sands Test Facility on May 6, 2010.

Michael Aftosmis, NASA Ames Research Center
michael.aftosmis@nasa.gov



Snapshots from the flight test and numerical simulations performed with NASA's Cart3D code. Simulations were used to develop an aerodynamic database for performance prediction and structural loads, which helped guide vehicle design. *Michael Aftosmis, NASA/Ames*